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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1209

AIRCRAFT GUN PROJECTILES

3rd Partial Report

ARMOR PENETRATION TESTS OF 20MM API PROJECTILE EX-5

FINAL Report

Copy No. 9

Task

Assignment MPG-R-3b-234-J-53

Classification CONFIDENTIAL
SECURITY INFORMATION

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NFO REPORT NO. 1209

Armor Penetration Tests of 20mm API Projectile Ex-5

PART A

SYNOPSIS

1. This report summarizes armor penetration tests conducted on the 20mm API Projectile Ex-5, now designated the 20mm API Projectile Mk 13 Mod 0, from initial development tests in September 1952 up to and including tests of the first two production lots performed in July 1953. These tests were conducted for the following purposes: to determine the armor piercing characteristics of the 20mm API Projectile Ex-5; to determine comparative penetration characteristics of the various types of 20mm API Ex-5, the 20mm APM95, and Caliber .50 APM2 projectiles; to establish penetration test velocities for the 20mm API Projectile Ex-5 for use in specification OS-2806.
2. On the basis of armor penetration, the 20mm API Projectile Ex-5 can be considered a satisfactorily effective projectile for service use.
3. The 20mm API Projectile Ex-5 is not quite as effective as the 20mm APM95 projectile in overall armor penetrating characteristics.
4. Except for an inferior performance by the unhardened body ZAL type, no significant difference in the overall terminal ballistic performance of the various types of 20mm API Ex-5 projectiles was noted.
5. Proposed specification velocities for acceptance testing of 20mm API Ex-5 projectiles have been determined and are given.

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Armor Penetration Tests of 20mm API Projectile Ex-5

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Armor Penetration Tests of 20mm API Projectile Ex-5

PART B

INTRODUCTION

1. AUTHORITY:

The subject tests were conducted under reference (a), Task Assignment NPG-Re3b-236-1-53, as authorized by references (b), (c), (d), (e), and (f).

2. REFERENCES:

- a. BUORD Rest ltr Re3b-AAF:mt NP9 of 30 July 1952
- b. BUORD Rest ltr Re3b-AAF:mt NP9 of 11 August 1952
- c. BUORD Rest ltr Re3b-AAF:mt NORD 11694 of 9 October 1952
- d. BUORD Rest ltr Re3b-AAF:mt NORD 11694 of 6 January 1953
- e. BUORD Rest ltr Re3b-AAF:mt NORD 11694 of 14 March 1953
- f. BUORD Conf ltr Re3b-AAF:hjk S78-1(20mm) Ser 55883 of 28 April 1953
- g. NAVPROV Rest ltr OTK:TWT:dmf X1-2a-20mm Ser 35050 of 25 August 1953 to BUORD

3. BACKGROUND:

Since September 1952 the Naval Proving Ground has been conducting tests of various models of the 20mm API Projectile Ex-5. Results of all tests were reported informally to the Bureau of Ordnance thereby facilitating the release of this projectile to production. The projectile, now designated the 20mm API Projectile Mk 13 Mod 0, is to be used in service with the 20mm Gun Mk 12. This report formally covers all the armor penetration tests performed on the 20mm API Projectile Ex-5 as requested by references (b), (c), (d), (e), and (f).

4. OBJECT OF TEST:

These tests were conducted for the following purposes:

- a. To determine the armor piercing characteristics of the 20mm API Projectile Ex-5.
- b. To determine comparative penetration characteristics of the various types of 20mm API Ex-5, the 20mm APM95, and Caliber .50APM2 projectiles.
- c. To establish penetration test velocities for the 20mm API Projectile Ex-5 for use in specification CS-2806.

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Armor Penetration Tests of 20mm API Projectile Ex-5

5. PERIOD OF TEST:

a. Dates of Directives	11 August 1952 9 October 1952 6 January 1953 14 March 1953 28 April 1953
b. First Test Reported Here	4 September 1952
c. Last Test Reported Here	27 July 1953

6. REPRESENTATIVES PRESENT:

The following representatives were present to witness portions of the tests reported herein:

A. A. Famiglietti	Bureau of Ordnance Re3b
A. N. Boardslee	Bureau of Ordnance Re3d
C. L. Mosler	AINSMAT, Reading Pa.
W. R. Powl	Armstrong Cork Company
J. R. Konold	Armstrong Cork Company
L. E. Killian	Armstrong Cork Company
G. A. Reinhard, Jr.	Armstrong Cork Company
H. M. Yohn	Armstrong Cork Company

Armor Penetration Tests of 20mm API Projectile Ex-5

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

The following projectiles were tested:

a. 20mm API Projectiles Ex-5 manufactured by Armstrong Cork Company of the types identified below:

<u>Type</u>	<u>Date</u>	<u>Body-Adapter Assembly</u>	<u>Body Hardening</u>
IVEBX	Sep 1952	Original design hot shrunk through die.	Hardened
IVEAL	Sep 1952	Original design hot shrunk only.	Not hardened
IVCB5	Nov 1952	Body adapter joint modified.	Hardened No. 5 grain size.
IVCB6	Nov 1952	Mechanically same as IVCB5.	Hardened No. 6 grain size.
IVCB7	Nov 1952	Mechanically same as IVCB5.	Hardened No. 7 grain size.
E2BLT	Jan 1953	New E2BT design.	Hardened
E2BLT-C	Mar 1953	E2BT design.	Hardened No. 2-1/2 grain size.
E2BLT-M	Mar 1953	E2BT design.	Hardened No. 5-1/2 grain size.
E2BLT-F	Mar 1953	E2BT design.	Hardened No. 7-1/2 grain size.
EX-5A8	May 1953	E2BT design.	Hardened
Mk 13 Mod 0	July 1953	E2BT design.	Hardened (see Figure 1)

Appendix (A), Figure 1 shows a cross section of the most recent type Ex-5 projectile obtained from the pilot lot of Mk 13 Mod 0 projectiles.

b. For comparative purposes 20mm APM95 projectiles from lot NP-3-24-45 and Caliber .50APM2 projectiles from lot SL-53925.

Armor Penetration Tests of 20mm API Projectile Ex-5

8. DESCRIPTION OF TEST EQUIPMENT:

a. Guns:

20mm Tube No. 34492
20mm Accuracy Barrels No. PAD-1 and Ex-178
Caliber .50 Accuracy Barrel No. 299

b. Cases and Powder:

20mm M21A1 Primed Case with IND 32774 Powder
20mm Mk 5-0 Case with Mk 47-0 Primer and IMR 6962
lot DSZA 8 Powder.
Caliber .50 Primed Case with RAD-20055 Powder

c. Armor:

1/2" and 3/4" Face Hardened Armor Carburized and
Pluramelt types
3/4" Homogeneous Armor (STS)
1" Homogeneous Armor (STS)
1-1/4" Homogeneous Armor (STS)

d. A 160' range with armor plate butt and velocity measuring equipment.

9. PROCEDURE:

The various types of 20mm API Projectiles Ex-5 listed in paragraph 7a were inert loaded to weight (1700 grains) with the exception of the EX-5A8 type and fired versus armor targets as listed in paragraph 8c. Ballistic limits were established for most of the conditions of test.

10. RESULTS AND DISCUSSION:

a. The ballistic results are summarized in Tables I to VI, Appendix (B), and are given in detail in Appendix (D) for each projectile-plate-obliquity combination. Photographs of typical projectiles after impact are contained in Figures 2 through 12, Appendix (C).

Armor Penetration Tests of 20mm API Projectile Ex-5

b. In the initial phase Caliber .50 APM2, 20mm APM95 and 20mm API Ex-5 projectiles of types EBX and EAL were tested against the same armor targets. To establish some comparison among these projectiles, limit penetration coefficients were calculated using the following formula:

$$P(e/d, \theta) = \frac{41.57 M^{1/2} VP50 \cos \theta}{e^{1/2} d}$$

$P(e/d, \theta)$ is limit penetration coefficient

e is the plate thickness in inches

d is the diameter of the projectile body in inches

M is the mass of projectile body in pounds

$VP50$ is the mean protection limit velocity in feet per second

θ is the obliquity (angle between trajectory and normal to plate at impact)

Characteristics of the projectiles were as follows:

<u>Projectile</u>	<u>Diameter of Core or Body Inches</u>	<u>Weight of Core or Body</u>
Caliber .50 APM2	.4272	.0560 pounds
20mm APM95	.7686	.2529 pounds
20mm API Ex-5 (Original Design)	.7686	*.1643 pounds

* Body weight of original design types EBX, EAL, and CB. The body weight of the new E2BT design was only .1613 pounds to provide for heavier adapter.

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Armor Penetration Tests of 20mm API Projectile Ex-5

Performances are compared in the table below:

<u>Conditions of Test</u>	<u>Projectile</u>	<u>"VP50" Limit ft./sec.</u>	<u>Limit Penetration Coefficient P(e/d.θ)</u>	<u>Limit Coefficient in terms of % of 20mm APM95 Limit</u>
1/2" Face Hardened 30°	Cal.50APM2	2502	70,000	131
"	20mm APM95	1639	53,450	100
"	20mm API Ex-5 (EBX)	1909	50,150	94
3/4" Homo. 30°	Cal.50APM2	2342	54,200	110
"	20mm APM95	1805	49,350	100
"	20mm API Ex-5 (EBX)	2691	59,300	120
1" Homo. 0°	Cal.50APM2	2404	55,750	103
"	20mm APM95	1972	54,000	100
"	20mm API Ex-5 (EBX)	2626	58,000	107
1-1/4 Homo. 0°	20mm APM95	>3006	>73,300	100
"	20mm API Ex-5 (EBX)	3115	61,250	<84

The above results indicate that the 20mm API Ex-5 (EBX) projectile requires less energy than the Caliber .50 APM2 or 20mm APM95 to penetrate 1/2" face hardened armor at 30° obliquity, but requires more energy to penetrate 3/4" homogeneous armor at 30° obliquity and 1" homogeneous armor at 0° obliquity than either the Caliber .50APM2 or 20mm APM95. Against 1-1/4" homogeneous at 0° obliquity the 20mm API Ex-5 (EBX) was able to penetrate but the 20mm APM95 could not. A possible explanation is that the long M95 body with soft base is upset during penetration where as the short relatively hard Ex-5 body does not deform during penetration. The 20mm Ex-5 (EAL) projectile with unhardened body showed poor armor penetrating characteristics as expected and as evident from the high ballistic limits obtained (Appendix (D)).

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Armor Penetration Tests of 20mm API Projectile Ex-5

c. In the second phase three types of 20mm Ex-5 projectiles identified as CB-5, 6 and 7 were tested. These projectiles were identical mechanically and varied only insofar as the heat treated grain size in the bodies. The bodies were No. 5, No. 6, and No. 7 grain size respectively which is not considered much variation. No difference in the armor penetration performance was noted against either 1/2" face hardened armor at 30° obliquity or 1" homogeneous armor at 0° obliquity.

d. Type E2BLT Ex-5 projectiles with a new strengthened body-adapter design to facilitate security of parts were next tested for penetration. These projectiles gave a similar penetration performance to types CB-5, 6 and 7 tested previously against both 1/2" face hardened armor at 30° obliquity and 1" homogeneous armor at 0° obliquity.

e. Three types of 20mm Ex-5 projectiles of the new body-adapter design with a wide spread in body grain size were given penetration tests. These projectiles were the E2BLT-C with a No. 2-1/2 (coarse) grain size, the E2BLT-M with a No. 5-1/2 (medium) grain size, and the E2BLT-F with a No. 7-1/2 (fine) grain size. Four ballistic tests were conducted in an attempt to detect the influence of this considerable variation in grain size. Tests against 1" and 1-1/4" homogeneous armor at 0° obliquity and against 3/4" face hardened armor at 20° obliquity did not distinguish between the three types. A test made with the projectiles at subzero temperature (-65°F) against 3/4" homogeneous armor at 30° obliquity showed a slightly poorer performance for the E2BLT-C coarse grain type. However, the differences among the three types of projectiles in overall ballistic penetration properties are not considered significant.

f. Two hundred 20mm EX-5A8 projectiles, incendiary loaded by National Fireworks Ordnance Corporation, were tested at the four different conditions of test to be included in the specifications. The results obtained are summarized in Appendix (B) along with the results obtained on the pilot lot and first two acceptance lots of 20mm Mk 13 Mod 0 projectiles. As regards acceptance ballistic testing of the Ex-5 projectiles, the following agreements were made at a meeting in the Bureau of Ordnance on 18 June 1953:

(1) That the present method given in OS-2806 of listing numerical velocities for a particular condition was satisfactory.

(2) That the Naval Proving Ground would furnish velocities for the desired conditions of test, to be listed in an amended OS-2806.

Armor Penetration Tests of 20mm API Projectile Ex-5

(3) That the protection criterion for complete penetration will be employed in the specification. Complete penetration will be considered to have occurred when a hole is produced in a 1/16" mild steel plate mounted approximately 6" behind and parallel to the armor plate, provided a through hole is evident in the armor.

(4) That the Bureau of Ordnance would authorize the Naval Proving Ground to obtain limit velocities on test plates with standard and acceptance lots of projectiles under the amended specification.

The following table lists the average performance to date for each condition of test and compares these average values with the velocities proposed in reference (g):

<u>Conditions of Test</u>	<u>No. Limits Determined</u>	<u>Average WVP50M Limit (Corrected to Nominal Thickness)</u>	<u>Specifi- cation Value Proposed</u>	<u>Specification value in Terms of % of Average Limit</u>
1/2" Face Hardened Pluramelt at 30°	5	2143 f.s.	2225 f.s.	103.8
1/2" Homo. 30°	6	1994 f.s.	2075 f.s.	104.1
3/4" Homo. 30°	6	2714 f.s.	2850 f.s.	105.0
1" Homo 0°	13	2687 f.s.	2800 f.s.	104.2

In view of the above results the proposed values should prove satisfactory for acceptance testing under OS-2806.

Armor Penetration Tests of 20mm API Projectile Ex-5
-----PART DCONCLUSIONS

11. It is concluded that:

a. On the basis of armor penetration the 20mm API Projectile Ex-5 can be considered a satisfactorily effective projectile for service use.

b. The 20mm API Projectile Ex-5 is not quite as effective as the 20mm APM95 projectile in overall armor penetrating characteristics.

c. Except for an inferior performance by the unhardened body EAL type, no significant difference in the overall terminal ballistic performance of the various types of 20mm API Ex-5 projectiles was noted.

d. Proposed specification velocities for acceptance testing of 20mm API Ex-5 projectiles have been determined.

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Armor Penetration Tests of 20mm API Projectile Ex-5

The tests upon which this report is based were conducted by:

T. W. TRUSLOW, Lieutenant (jg), USNR-R
Firing Officer
Light Armor Battery
Terminal Ballistics Department

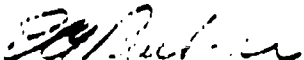
This report was prepared by:

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C. C. BRAMBLE, Director of Research, Ordnance Group

APPROVED: J. F. BYRNE
Captain, USN
Commander, Naval Proving Ground



E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

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NPG REPORT NO. 1209

**U. S. NAVAL PROVING GROUND
Dahlgren, Virginia**

**Third Partial Report
on
Aircraft Gun Projectiles**

**Final Report
on
Armor Penetration Tests of
20mm API Projectile Ex-5**

X

**Project No.: NPG-Re3b-236-1-53
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Date: NOV 25 1953

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AUG. 1953

HARDNESS DISTRIBUTION AND MACROSECTION OF 20MM AP PROJECTILE MK 13-0 PILOT LOT

Hardness Values: Vickers Pyramid (50kg.)

Etch: Ammonium Persulfate

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Security Information

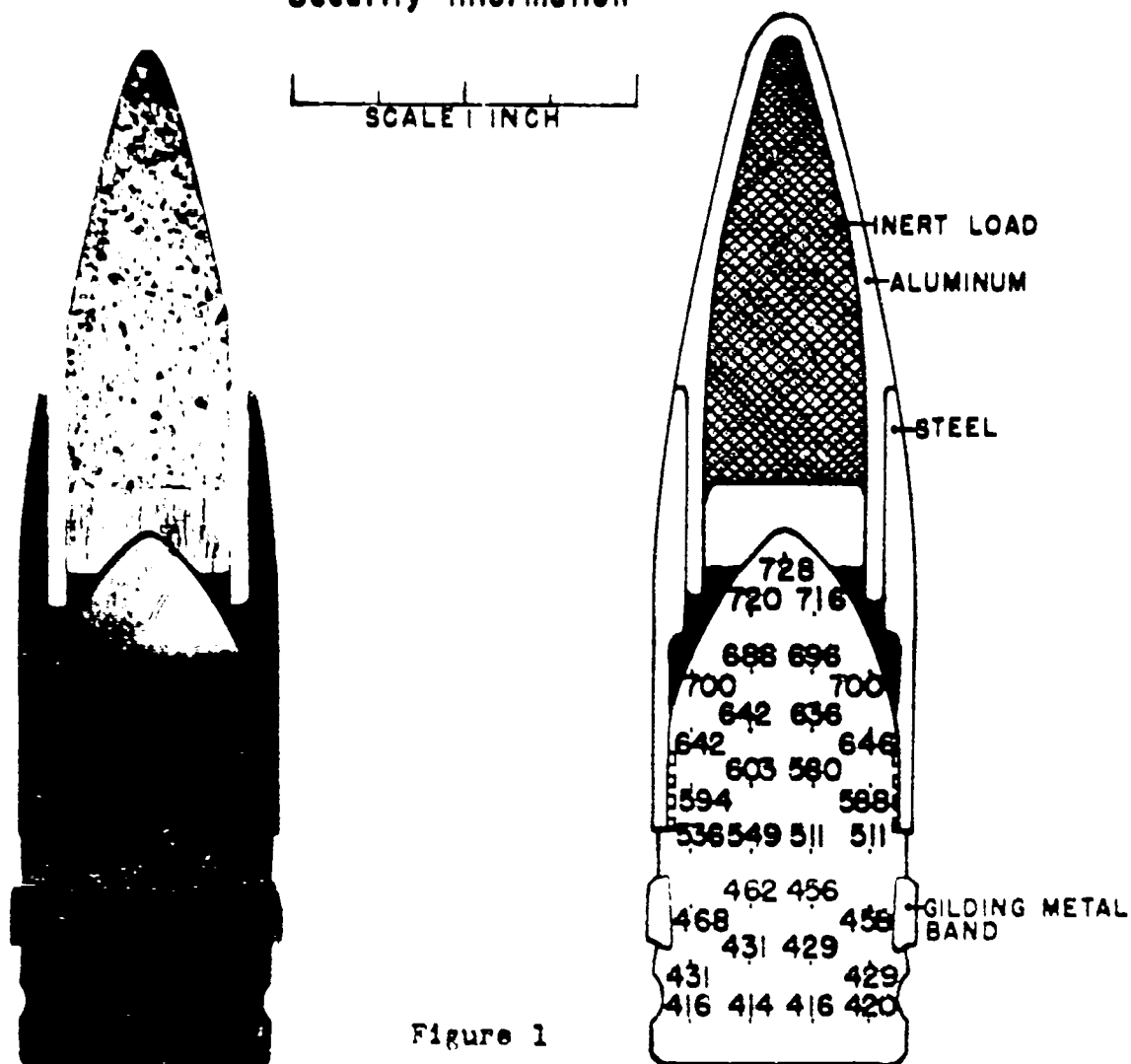


Figure 1

TABLE I

SUMMARY OF BALLISTIC RESULTS 1/2" FACE HARDENED ARMOR 30° ON INCLINITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPMIN" Limit Ft./sec.	"VPSO" Limit Ft./sec.	Remarks
1	20mm Ex-5	EMK	Diston- Carburized	0.522	1909	1909	
4	20mm Ex-5	EAL	Diston- Carburized	0.522	2440	2440	
7	20mm APMS6	--	Diston- Carburized	0.522	1639	1639	
--	Cal. 50AMP2	--	Diebold- Carburized	0.508	--	2502	Reported NPG Report No. 478 of 19 January 1950.
12	20mm Ex-5	CB-5	Diston- Carburized	0.516	1817	1842	
14	20mm Ex-5	CB-6	Diston- Carburized	0.516	1811	1830	
16	20mm Ex-5	CB-7	Diston- Carburized	0.516	1828	1864	
18	20mm Ex-5	E2HLT	Diston- Carburized	0.516	1856	1862	
37-38	20mm Ex-5	A-8	Diston- Carburized	0.496	1934	1995	
39-40	20mm Ex-6	A-8	Reading- Pluramelt	0.506	2203	2242	
41	20mm Ex-6	A-8	Reading- Pluramelt	0.506	2030	2044	
--	20mm Mk 13 Mod 0	Pilot Lot	Reading- Pluramelt	0.506	2126	2257	Reported in Refer- ence (g).
--	20mm Mk 13 Mod 0	Lot 1-3	Reading- Pluramelt	0.506	2102	2169	"
--	20mm Mk 13 Mod 0	Lot 2-3	Reading- Pluramelt	0.506	2087	2087	"

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APPENDIX B

TABLE II

SUMMARY OF BALLISTIC RESULTS 3/4" HOMOGENEOUS ARMOR 30° ORBLIQUITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPMIN" Limit Pt./sec.	"VPSO" Limit Pt./sec.	Remarks
1-2	20mm Ex-5	EHL	Carnegie ST8	0.742	2691	2691	
4-5	20mm Ex-5	EAL	"	0.742	2874	2874	
7-8	20mm APMS5	--	"	0.742	1805	1805	
11	Cal. 50APM2	--	"	0.742	2294	2342	
26-27	20mm Ex-5	E2HLT-C	"	0.739	2701	2808	Projectiles at sub-zero temp. (-65°F)
28	20mm Ex-5	E2HLT-M	"	0.739	2665	2733	"
29-30	20mm Ex-5	E2HLT-P	"	0.739	2800	2708	"
34	20mm Ex-5	A-8	"	0.736	2723	2723	"
35-36	20mm Ex-5	A-8	"	0.736	2599	2692	"
--	20mm Mk 13 Mod 0	Pilot Lot	"	0.737	2753	2753	Reported in Reference (8).
--	20mm Mk 13 Mod 0	Lot 1-3	"	0.737	2643	2661	"
--	20mm Mk 13 Mod 0	Lot 2-3	"	0.737	2578	2633	"

TABLE III

SUMMARY OF BALLISTIC RESULTS 1" HOMOGENEOUS ARMOR 0° OBLIQUITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPMH" Limit Ft./sec.	"VP50" Limit Ft./sec.	Remarks
2-3	20mm Ex-5	EHX	Carnegie STS	0.986	2612	2626	
6	20mm Ex-5	EAL	"	0.986	2997	2997	
8	20mm APMS5	--	"	0.986	1972	1972	
10	Cal. 50APM2	--	"	0.986	2404	2404	
13	20mm Ex-5	CB-5	"	0.986	2630	2630	
15	20mm Ex-5	CB-6	"	0.986	2653	2653	
17	20mm Ex-5	CB-7	"	0.986	2631	2631	
19	20mm Ex-5	E2HLT	"	0.982	2626	2644	
20-21	20mm Ex-5	E2HLT-C	"	0.982	2652	2661	
23	20mm Ex-5	E2HLT-M	"	0.982	2646	2646	
24	20mm Ex-5	E2HLT-P	"	0.989	2674	2674	
42	20mm Ex-5	A-8	"	0.989	2694	2694	
--	20mm Mk 13 Mod 0	Pilot Lot	"	0.989	2721	2725	Reported in Reference (g).
--	20mm Mk 13 Mod 0	Pilot Lot	"	0.985	2665	2683	"
--	20mm Mk 13 Mod 0	Lot 1-3	"	0.989	2712	2712	"
--	20mm Mk 13 Mod 0	Lot 2-3	"	0.989	2699	2699	"

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APPENDIX B

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TABLE IV

SUMMARY OF BALLISTIC RESULTS 1-1/4" HOMOGENEOUS ARMOR AT 0° OBLIQUITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPMIN" Limit Ft./sec.	"VPMAX" Limit Ft./sec.	Remarks
3	20mm Ex-5	EHX	Carnegie ST3	1 1/2 1/4	3115	3115	
9	20mm APMS6	--	"	1 1/2 1/4	> 3006	> 3008	
21	20mm Ex-5	E2HLT-C	"	1 1/2 1/4	3223	3223	
23	20mm Ex-5	E2HLT-M	"	1 1/2 1/4	3241	3241	
25	20mm Ex-5	E2HLT-F	"	1 1/2 1/4	3261	3261	

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APPENDIX B

TABLE V

SUMMARY OF BALLISTIC RESULTS 3/4" FACE HARDENED ARMOR AT 20° OBLIQUITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPMIN"		"VP50"		Remarks
					Limit	Ft./sec.	Limit	Ft./sec.	
20	20mm Ex-5	E2BLT-C	Reading- Fluoromelt	0.766	2342		2342		
22	20mm Ex-5	E2BLT-M	"	0.766	2283		2306		
24	20mm Ex-5	E2BLT-F	"	0.766	2312		2339		

TABLE VI

SUMMARY OF BALLISTIC RESULTS 1/2" HOMOGENEOUS ARMOR AT 30° OBLIQUITY

Appendix (D) Page No.	Projectile	Type	Plate	Thickness	"VPHIN" Limit Ft./sec.	"VP60" Limit Ft./sec.	Remarks
31	20mm Ex-5	A-8	Carnegie STS	0"501	1939	1939	
32	20mm Ex-5	A-8	"	0"499	2013	2013	
33	20mm Ex-5	A-8	"	0"498	1978	1978	
--	20mm Mk 13 Mod 0	Pilot Lot	"	0"501	1972	1972	Reports in Refer- ences (g).
--	20mm Mk 13 Mod 0	Lot 1-3	"	0"499	2031	2031	"
--	20mm Mk 13 Mod 0	Lot 2-3	"	0"499	2025	2025	"

AP M95



1



2



3



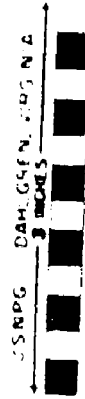
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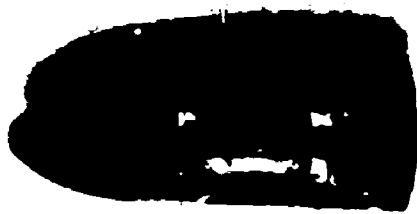
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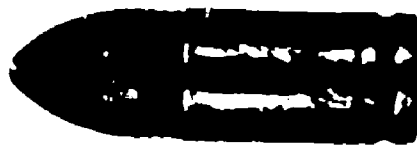
AP M95



1



2



6



7



AP M95



1

4

5

9

11

12

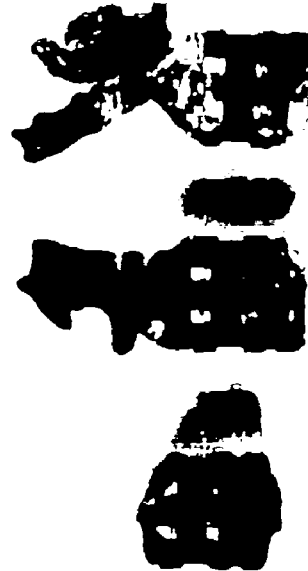


EAL



1 5 7 8 10 11

EBX



1 2 3 5 9 11



EAL

|



1

2

3

4

EBX

|



1

5

7

10

12

13



EAL



3

4

EBX



1

2

4

5

7

10



EBX



2 5 7

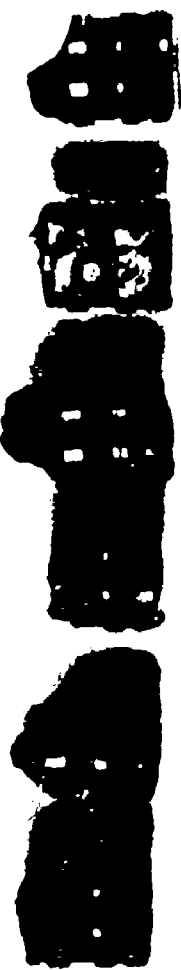


CB5



1 3 4 6 9 11

CB6

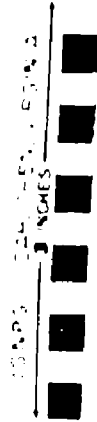


1 3 5 6 7 13

CB7



1 2 3 6 12 13



CB5



2 3 4 6

CB6



3 4 10

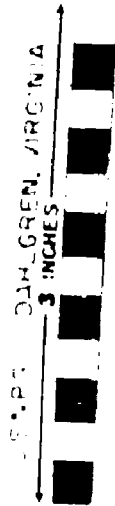
CB7



3 4 5



E2BLT



E2BLT



1 2 7

USNPG DAHLGREN, VIRGINIA



NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Time

YP:
TS:
EL:
RA:

Proj : 20MM API 20MM API 20MM API
Gun : FAD-1 FAD-1 FAD-1
Range :
Plate :
Gauge :
Obl. :
Req : 25
LC :
HI :
Limit :

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

3,8
Date : 4 SEPT 1952
Mfr : ARMSTRONG CORP
Contr : EXPERIMENTAL
Specs :
Proj : 20MM API EXS (4-50K)
Group : 450K - HARDENED CORP
Heat :
Steel : -

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	20MM	1695grs	300	1983	30°	0	X-R	Nose chipped off 3/8" Pen
2	"	"	300	1970	30°	0	X-R	Nose chipped off 1/2" Pen
3	"	"	260	1808	30°	0	T-R	" " " SB
4	"	"	280	1884	30°	0	T-R	Not Penetrated SB
5	"	"	290	1970	30°	0	X-R	Nose chipped off 3/8" Pen
6	"	"	285	1916	30°	0	X-R	" " " 1/2" Pen
7	"	"	285	1963	30°	0	Diagonal split old round	
8	"	"	280	1884	30°	0	T-R	Nose chipped off SB
9	"	"	285	1903	30°	0	T-R	" " " Pen 5/8"
10	"	"	285	1854	30°	Slight	T-R	" " " SB
11	"	"	285	1915	30°	0	X-R	" " " 1/2" Pen
12	"	"	285	1858	30°	0	T-R	" " " SB
13	"	"	285	1885	30°	0	T-R	" " " SB
14	"	"	285	1901	30°	0	T-R	" " " Pen 5/8"
Plate 1554								
1	450K	1695grs	340	2185	30°	0	T-R	Intact HB
2	CONFIDENTIAL		2370	30°	0	T-R	Broken up	HB
3	SECURITY INFORMATION		2182	30°	0	T-R	Intact.	HB

NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

S78-1(54-20mm

Encl. ()

20MM API-EX5
EBX

36226-14

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
4	EX5-EBX	16956gms	400	2267	30	0	T-RJ	Intact HB
5	"	"	430	2411	30	0	T-RJ	Nose off HB
6	"	"	500	2672	30	0	I-CIP	Intact HB 5/8"
7	"	"	540	2819	30	0	X-RJ	Nose off 3/4" Hole
8	"	"	540	2824	30	0	Disregard	hit primed.
9	"	"	540	2742	30	0	X-RJ	Nose off 3/4" Hole
10	"	"	520	2846	30	0	C-R	Nose off 3/4" Hole
11	"	"	500	2631	30	0	I-CIP	Intact HB 1 1/8"
12	"	"	500	2709	30	0	X-FIP	Nose off 1 1/8" Hole
13	"	"	510	2722	30	0	X-FIP	Nose off 3/4" Hole
14	"	"	490	2662	30	0	I-FIP	Nose broken. Pin 5/8"
15	"	"	490	2641	30	0	I	

Plate 1068-ST5

1	EX5-EBX	1695	540	2813	0	0	C	Intact 3/4" Hole
2	"	"	500	2707	0	0	C	Intact 3/4" Hole
3	"	"	480	2553	0	0	I-CIP	Intact 1/2" Nose
4	"	"	490	2624	0	0	C	Intact 3/4" Hole
5	"	"	480	2727	0	0	C	Intact 3/4" Hole
6	"	"	480	2600	0	0	I-CIP	Intact 7/8" Nose
7	CONFIDENTIAL		480	2667	0	0	C	Intact 3/4" Hole
8	SECURITY INFORMATION		480	2628	0	0	I-CIP	Intact 1" Nose

Page 2

SHEET NO. _____

Encl. ()

8 Sept 1952

Page 3

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Time

Proj : 20MM API-EA EA-20MM EA-20MM
Gun : FAD-1 FAD-1 FAD-1
Range :
Plate : M.H. DISTON 575-1554 575-1069
Gauge : 0.522 0.742 0.996
Obl. : 30° 300 00
Req ± 25 :
LC : 2480 2994 3012
HI : 2400 2974 2972
Limit : 2440 2979 2997

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

5, 9,
Date : 4 SEPT 1952
Mfr : ARMSTRONG CORP
Contr : EXPERIMENTAL
Specs :
Proj : 20MM API EX-5 (4EA-5)
Group : EA-EAL-DIMARTINCO
Heat :
Steel : -

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	20MM API-EA	1692 ± 10-7	290	1882	30°	0	T-R	Nose chipped off SB
2	"	"	300	2066	30°	0	T-R	Bulging SB
3	"	"	320	2094	30°	0	T-R	Nose chipped off SB
4	"	"	340	2148	30°	0	Diagonal hit	penetrated
5	"	"	380	2382	30°	0	T-R	Bulging 30° E.P.
6	"	"	420	2403	30°	0	Diagonal hit	5 1/4" E.P.
7	"	"	430	2518	30°	0	X-R	Nose chipped off 3/4" E.P.
8	"	"	420	2480	30°	0	X-R	Nose off 3/4" E.P.
9	"	"	400	2473	30°	0	Diagonal hit	penetrated
10	"	"	380	2263	30°	0	T-R	Nose off SB
11	"	"	400	2400	30°	0	T-R	Nose off MB
Plate STS-1554								
1	EAL	1692	600	3044	30°	0	C	Nose chipped off 1 1/4" E.P.
2	"	"	500	2802	30°	0	T-R	Nose chipped off 1 1/4" E.P.
3	"	"	500	2694	30°	0	T-R	Nose chipped off HB
4	"	"	520	2740	30°	0	T-R	NB
CONFIDENTIAL				2843	30°	0	Diagonal hit	did not
6	SECURITY INFORMATION	540	2874	30°	0	X-R	Nose off	3/4" E.P.

Page 4

SHEET NO. _____

Encl. ()

436291-14

Page 5

SHEET NO. _____

Encl. ()

PLATE 1" STS - 0° - No 1068

[illegible]

Page 6

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Time

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

CORE WT-1770

Proj : 20MM APMS 20MM M5 20MM M195
Gun : 8057 : 34492 : 34492
Range : 2
Plate : 1 (Paschard) STS : STS-1068
Gauge : 0.522 : 0.742 : 0.986
Obl. : 30° : 30° : 0°
Req ± 25 :
LC : 1639 : 1805 : 1978
HI : 1639 : 1805 : 1965
Limit : 1639 : 1805 : 1972

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

5, 8,
Date : 4, Sept 1952
Mfr : National Pneumatic
Contr : EXP. TEST.
Specs :
Proj : 20MM APMS
Group : Lot 3-24-45
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	20MM APMS 1980 Gms	1289 Gms	200	1432	30°	0	I	NR - 1/8"
2	"		250	1639	30	0	C	NR - 1/8" x 1/8" C Pen
3	"		230	1545	30	0	I	RI - Pen 5 3/4"
4	"		230	1563	30	0	I	RI - Pen 5 3/4"
5	"		235	1533	30	0	Penet	NR - 1/8" x 1/8" C Pen
6	"		230	1521	30	0	I	RI - 5/8"
7	"		235	1510	30	0	I	RI - 1/8"
8	"		240	1500	30	0	I	RI - 1/8"
9	"		250	1533	30	0	I	RI - 1/8"
10	"		275	1639	30	0	I	RI - 5/8"
11	"		300	1785	30	0	C	NR - 3/4" x 1/8" C Pen
12	"		275	1675	30	0	C	NR - 5/8" x 3/4" C Pen
STS-A-1554								
1	20MM APMS		310	1919	30°	0	X RIP	Broken up 3/4" Nose
2	"		290	1764	30°	0	I RIP	Broken up Pen 5/8"
3	"		300	1805	30°	0	X RIP	Nose off 3/4" Nose
4	"		300	1805	30°	0	I CP	Intact 1/8" Nose
5	"		295	1777	30°	0	I RIP	Nose off 1/8" Nose

SHEET NO. _____

Encl. ()

575 - 1068 - 0"986

Page 8

SHEET NO. _____

Encl. ()

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
1	44 SM 45	1980 GRAMS	500	2792	0	0	I RND UP	MB
2	"	"	520	2903	0	0	I RND UP	MB
3	"	"	510	2843	0	0	I RND UP	MB
4	"	"	540	2711	0	0	I RND UP	MB
5	"	"	580	2862	0	0	I RND UP	MB
6	"	"	600	2943	0	0	I RND UP	MB
7	"	"	610	3006	0	0	I RND UP	MB
8	"	"	500	2594	0	0	I RND UP	MB
9	"	"	480	2535	0	0	I RND UP	MB
10	"	"	480	2460	0	0	I RND UP	MB
11	"	"	480	2551	0	0	I RND UP	MB
12	"	"	480	2475	0	0	I RND UP	MB

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NAVAL PROVING GROUND
LIGHT ARMOR BATTERY

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Temperature

Time

YP:
TS:
EL:
RA:

Proj : Cal 50 M2 : Cal 50 M2
Gun : 299 : 299
Range : 1 : 1
Plate : 975-10000 : 975-1554
Gauge : 0.986 : 0.742
Obl. : 0 : 30
Req ± 25 : 0 : 30
LC : 2409 : 2295
HI : 2399 : 2292
Limit : 2404 : 2294

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 5, 8, Sept 1952
Mfr :
Contr : EXP.
Specs :
Proj : Cal 50 APM2
Group :
Heat :
Steel :

+36236-1.4

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	Cal 50 M2	1068	15.4	2668	0	0	C	Not Penetrated 7/16" Hole
2	"		14.9	2545	0	0	C	Not Penetrated 7/16" Hole
3	"		14.0	2391	0	0	5 B	" 1/8" Hole
4	"		14.5	2568	0	0	C	" 7/16" Hole
5	"		14.2	2493	0	0	C	" 7/16" Hole
6	"		14.2	2459	0	0	C	" 7/16" Hole
7	"		14.0	2493	0	0	C	" 7/16" Hole
8	"		13.8	2387	0	0	D	Not Penetrated Hit Old Head
9	"		14.0	2409	0	0	C	Not Penetrated 7/16" Hole
10	"		13.8	2381	0	0	I CR	1" Hole
11	"		13.8	2477	0	0	C	Not Penetrated 7/16" Hole
12	"		13.6	2399	0	0	I CR	1/2" Hole
13	"		13.6	2391	0	0	I CR	1" Hole
Plate No A-1554								
1	Cal 50 M2		14.9	2577	30	0	C	NR 7/16" Hole
2	"		13.8	2391	30	0	I CR	1/2" Hole
3	"		14.9	2449	30	0	C	NR 7/16" Hole
4	"		13.6	2393	30	0	C	NR 7/16" Hole

CONFIDENTIAL

SECURITY INFORMATION

(Page 10)

SHEET NO. _____

Encl. ()

8 Sept 1952

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NAVAL PROVING GROUND
LIGHT ARMOR BATTERY

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Time

YP:
TS:
EL:
RA:

Proj : 5X-5 CB-3
Gun : FAD-1
Range : 1
Plate : F.M. 2000 ft
Gauge : 0.516
Obl. : 30°
Req ± 25 : 1829
LC : 1805
HI : 1817
Limit : 1812

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 5, 6, NOV. 1952
Mfr : ARMSTRONG CORP
Contr : EXA
Specs : --
Proj : 20MM API EX-3
Group : IX CB-3
Heat : --
Steel : --

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-3	1695	285	1782	30	0	T R	SB
2			285	2042	30	0	X	SB
3			270	1892	30	0	X	SB
4			260	1887	30	0	X	SB
5			245	1741	30	0	T R	SB
6			250	1805	30	0	T R	SB
7			255	1858	30	0	T R	SB
8			255	1843	30	0	X	SB
9			253	1798	30	0	T R	SB
10			258	1835	30	0	T R	SB
11			260	1829	30	0	X	SB
12			260	1849	30	0	T R	SB
13			258	1793	30	0	T R	SB
14			258	1839	30	0	T R	SB
15			255	1803	30	0	T R	SB
16	V	V	255	1778	30	0	T R	SB

CONFIDENTIAL

SECURITY INFORMATION

SHEET NO. 1
Encl. ()

Date : 5, 6, Nov. 1952
Mfr : ARMSTRONG CORP
Contr: EXA
Specs: —
Proj : 20MM APX EX-5
Group: IX C D-5
Heat : —
Steel: —

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Temperature

Time

Encl. ()

YP:
TS:
EL:
RA:

Proj	27-21206
Gun	FAD-1
Range	1
Plate	RM2000
Gauge	0" 51 6
Obl.	30°
Req ± 25	
LC	1816
HT	1806
Limit	1811

C : Date : 5, 6, Nov. 1952
Mn: Mfr : ARMSTRONG CORP.
S : Contr: EXP.
P : Specs: —
Sl: Proj : 20MM EX-5(4P3)
Ni: Group: INC B 6
Cr: Heat : —
Mo: Steel: —

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	FX-5 255A6 JENERT	1615X106m	295	1993	30	0	X	3/4" CPW 11x2 1/2"
2			270	1925	30	0	X	3/4" CPW
3			270	1910	30	0	X	3/4" CPW
4			260	1873	30	0	X	3/4" CPW
5			250	1806	30	0	I R3	SB
6			255	1830	30	0	I R3	SB
7			255	1816	30	0	X	1/2" CPW
8			255	1774	30	0	I R3	SB
9			255	1777	30	0	I R3	MB
10			258	1795	30	0	I R3	PUN 5 3/16"
11			260	1840	30	0	X	7/8" CPW
12			255	1819	30	0	I R3	SB
13	✓	✓	258	1847	30	0	I R3	PUN 5 1/8"

CONFIDENTIAL

SECURITY INFORMATION

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Time

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Proj : EX-3 SEC-4
Gun : FAD-1
Range : 1
Plate : STS-C-1048
Gauge : C 1986
Obl. : 12
Req : 25
LC : 12453
HT : 12453
Limit : 12453 2453

C :
Mn:
S :
P :
Si:
Ni:
Cr:
Mo:

Date : 36 Nov. 1952
Mfr : ARMSTRONG CORP.
Contr : EXP
Specs :
Proj : 20MM APF EX-3
Group : IX C 56
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-3 1986	11453200	490	2626	0	0	I up	Inner 70% 1/4 GBT
2			490	2674	0	0	I up	Inner 70% 1/4 GBT
3			490	2670	0	0	C	Inner 70% 1/4 GBT
4			495	2676	0	0	C	Inner 70% 1/4 GBT
5			490	2631	0	0	I up	Inner 70% 1/4 GBT
6			490	2636	0	0	I up	Inner 70% 1/4 GBT
7			490	2653	0	0	I up	Inner 70% 1/4 GBT
8			490	2645	0	0	I up	Inner 70% 1/4 GBT
9			490	2629	0	0	I up	Inner 70% 1/4 GBT
10			490	2653	0	0	C	Inner 70% 1/4 GBT

CONFIDENTIAL

SECURITY INFORMATION

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Time

YP:
TS:
EL:
RA:

Proj : ~~EX-5~~
Gun : ~~AP-1~~
Range :
Plate : ~~EX-5~~
Gauge : 0.516
Obl. : 30°
Req : 25
LC : 1929
HI : 1916
Limit : 1920

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 5, 6, Nov. 1952
Mfr : ARMSTRONG CORP.
Contr : EXP
Specs :
Proj : 30mm EX-5 (APF)
Group : C-8-7
Heat :
Steel : —

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-5	14952	265	2053	30°	0	X	3/8" CR
2			270	1901	30°	0	I R3	PW 5 1/2"
3			270	1903	30°	0	X	3/8" CR
4			260	1876	30	0	X	7/8" CR
5			250	1812	30	0	I R3	3/8" RWS
6			255	1816	30	0	I R3	PW 5 1/2"
7			255	1853	30	0	X	3/4" CR
8			253	1781	30	0	I R3	SB
9			255	1843	30	0	I R3	MB
10			258	1794	30	0	I R3	SB
11			265	1909	30	0	X	5/8" CR
12			253	1813	30	0	I R3	SB
13			258	1839	30	0	X	3/4" CR
14			260	1814	30	0	I R3	SB
15			257	1840	30	0	I R3	SB
16	N	✓	265	1897	30	0	X	7/8" CR
CONFIDENTIAL								
SECURITY INFORMATION								

Rev. 16

SHEET NO. 1
Encl. ()

YP:
TS:
EL:
RA:

Date : 56 NOV. 1952
Mfr : ARMSTRONG CORK
Contr: EXR
Specs: —
Proj : 20MM EX-5 (AP)
Group: IX-C 87
Heat : —
Steel: —

[illegible]

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :
YP:
TS:
EL:
RA:

Proj : **EX-5**
Gun : **34492**
Range : **1**
Plate : **PN300004**
Gauge : **0.516**
Obl. : **30°**
Req : 25
LC : **117**
HI : **112**
Limit : **158**

C :
Mn:
S :
P :
Si:
Ni:
Cr:
Mo:

Date : **15 FEB 1953**
Mfr : **ARMSTRONG CORP**
Contr : **EXR NORDEN**
Specs :
Proj : **EX-5(AS) TYPE B2BLT**
Group : **REC'D JAN-53**
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-5	1700	280	1795	30	0	I	Lost
2	"	"	290	1796	30	0	I	Drunk up
3	"	"	300	1846	30	0	X	Lost
4	"	"	290	1792	30	0	I	Drunk up
5	"	"	295	1864	30	0	I	Drunk up
6	"	"	295	1891	30	0	X	Drunk up
7	"	"	293	1836	30	0	I	Drunk up
8	"	"	295	1857	30	0	X	"
9	"	"	295	1876	30	0	X	"
10	"	"	295	1860	30	0	I	"
11	"	"	295	1900	30	0	X	"
12	"	"	295	1855	30	0	I	"
13	"	"	295	1886	30	0	X	"
14	"	"	295	1866	30	0	I	"

CONFIDENTIAL

SECURITY INFORMATION

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Time

YP:
TS:
EL:
RA:

Proj : **EX-5 E2BLT**
Gun : **34492**
Range : **1**
Plate : **ST-1000**
Gauge : **0.986**
Obl. : **0**
Req : 25
IC : **2638**
HI : **2614**
Limit : **2626**

C :
Mn:
S :
P :
Si:
Ni:
Cr:
Mo:

Date : **5 FEB. 1953**
Mfr : **ARMSTRONG CORP**
Contr : **EXA NORTH**
Specs : **—**
Proj : **EX-5 (AP3) TYPE E2BLT**
Group : **REC'D JAN - 1953**
Heat : **—**
Steel : **—**

T 26234 1.4

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	E2BLT EX-5	1700±20	430	2662	0	0	C	Intact 3 1/2" Nose
2	"	"	415	2553	0	0	I (CP)	Intact 1 1/2" Nose
3	"	"	420	2612	0	0	I (CP)	Intact 3 1/2" Nose
4	"	"	422	2592	0	0	I (CP)	Intact 1 1/2" Nose
5	"	"	425	2597	0	0	Disrupted hit olded	
6	"	"	427	2610	0	0	I (CP)	Intact 3 1/2" Nose
7	"	"	430	2638	0	0	C	Intact 3 1/2" Nose
8	"	"	425	2614	0	0	I (CP)	Intact 7 1/2" Nose
9	"	"	427	2614	0	0	I (CP)	Intact 5 1/2" Nose
10	"	"	430	2600	0	0	I (CP)	Intact 1 1/2" Nose
11	"	"	430	2607	0	0	I (CP)	Intact 7 1/2" Nose
12	"	"	430	2645	0	0	I (CP)	Intact 1 1/4" Nose
13	"	"	430	2648	0	0	I (CP)	Intact 1 1/2" Nose

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SECURITY INFORMATION

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NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
Time

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Proj : 5 E 282 T C
Gun : 21.5 : 21.5 : 21.5
Range : 11.117 : 11.117 : 11.117
Plate : 11.117 : 11.117 : 11.117
Gauge : 0.766 : 0.766 : 0.766
Obl. : 20° : 0° : 0°
Req ± 25 : 25 : 25 : 25
LC : 2342 : 2342 : 2342
HI : 2342 : 2342 : 2342
Limit : 2342 : 2342 : 2342

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :
Date : 18 MARCH 1953
Mfr : ACME TRUCK CO.
Contr : EXP.
Specs : EXP.
Proj : EX-3 AP
Group : COURSE GRAIN SIZE 2 1/2
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	562074	GRAINS 1700	325	1923	20°	-	T, RT	Has channel of penetration
2	"	"	350	2073	"	-	T, RT	" " " " " "
3	"	"	400	2185	"	-	T, RT	" " " " " "
4	"	"	450	2402	"	-	X, RT	Has channel off to band of
5	"	"	440	2376	"	-	X, RT	Has channel off to band of
6	"	"	430	2332	"	-	T, RT	Has channel off to band of
7	"	"	435	2342	"	-	T, RT	Has channel off to band of
8	"	"	438	2353	"	-	X, RT	" " " " " "
9	"	"	435	2342	"	-	X, RT	" " " " " "
10	"	"	430	2328	"	-	T, RT	Has channel off to band of
11	"	"	432	2343	"	-	T, RT	Has channel off to band of
PLATE 2 - 1068 1"								
1	562074	GRAINS 1700	500	2626	0°	-	T, RT	" " " " " "
2	"	"	510	2684	0°	-	T, RT	" " " " " "
3	"	"	505	2648	0°	-	T, RT	" " " " " "
4	"	"	505	2650	0°	-	T, RT	" " " " " "
5	"	"	507	2665	0°	-	T, RT	" " " " " "

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SECURITY INFORMATION

NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

~~SECRET~~

Encl. ()

5E2BLT-C (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
6	5E2BLT-C	GRAINS 1700520	507	2665	0	-	T, C, I, R	INTACT
7	"	"	507	2650	0	-	T, C, I, R	"
8	"	"	507	2653	0	-	C	"
9	"	"	507	2662	0	-	C	"

PLATE 3 STS 14"

1	5E2BLT-C	"	662	3Y14	0°	SUBT	T, C, I, R	3" Hole, INTACT
2	"	"	662	3Y61	0°	"	C	INTACT, disc cracked
3	"	"	662	3Y68	0	"	C	"
4	"	"	660	3Y57	0	0°	C	"
5	"	"	655	3Y61	0	SUBT	C	" , Hole cracked
6	"	"	655	3Y31	0	"	C	" " "
7	"	"	652	3Y42	0	"	C	"
8	"	"	650	3Y31	0	"	C	" , disc cracked

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SECURITY INFORMATION

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NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
~~CONFIDENTIAL~~

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

5 E 2 8 L T-M

Proj : 2X-5 2X-5 2X-5
Gun : 2A178 2A178 2A178
Range : 1,160 FT 1 1
Plate : 99235-03 1068, 875 875
Gauge : 07766 07982 17244
Obl. : 20° 0° 0°
Req ± 25 :
LC : 2296 2643 3250
HI : 2269 2643 3231
Limit : 2253 2646 3241

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 18 MARCH 1953
Mfr : ARMSTRONG CORP.
Contr : EXA
Specs : EXA
Proj : EX-5 API
Group : MEDIUM GROW SIZE 5 1/2
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	2X-5	GRAINS 17244	325	2130	20°	-	T. M	Has band to band
2	"	"	350	1932	20°	-	T. M	" " " " " "
3	"	"	400	2168	20°	-	T. M	Has band off to band
4	"	"	425	2212	20°	-	T. M	Has band off to band
5	"	"	441	2361	20°	-	X. M	Has band off to band
6	"	"	435	2349	20°	-	X. M	Has band off to band
7	"	"	432	2376	20°	-	X. M	" " " " " "
8	"	"	430	2330	20°	-	X. M	" " " " " "
9	"	"	430	2324	20°	-	X. M	" " " " " "
10	"	"	428	2312	20°	-	X. M	" " " " " "
11	"	"	425	2296	20°	-	X. M	" " " " " "
12	"	"	425	2303	20°	-	T. M	" " " " " "
13	"	"	422	MISS	20°	-	X. M	" " " " " "
14	"	"	422	2307	20°	-	T. M	" " " " " "
15	"	"	420	2256	20°	-	T. M	Has band off to band
16	"	"	424	2305	20°	-	T. M	Has band off to band
17	"	"	424	2319	20°	-	T. M	Has band off to band

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SECURITY INFORMATION

NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

S78-1(54-20mm

Encl. ()

5E2BLT-M (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
Plate 2 - 1068 1"								
1	5E2BLT-M	GRAINS 1710 ± 20	500	2612	0	-	I cup	Intact
2	"	"	510	2626	0	-	I cup	"
3	"	"	510	2681	0	-	C	"
4	"	"	505	2643	0	-	I cup	"
5	"	"	507	2667	0	-	C	"
6	"	"	507	2629	0	-	I cup	"
7	"	"	507	2655	0	-	C	"
8	"	"	507	2660	0	-	C	"
9	"	"	505	2648	0	-	C	"
Plate 3 5TS 1 1/4"								
1	5E2BLT-M	GRAINS 1700 ± 20	662	3257	0	slight C		Top of nose off
2	"	"	662	M.S.S.	0	0 C		" " " "
3	"	"	662	3250	0	0 C		Intact
4	"	"	655	3231	0	0		Disrupted. Nitro old impact
5	"	"	655	3231	0	slight I cup		5" Hole
6	"	"	655	3221	0	0 I cup		1/2" Hole
CONFIDENTIAL								
SECURITY INFORMATION				Page 23				

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
Time

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Proj : 5E 28LT-F
Gun : 121-5 121-5 121-5
Range : 121-178 121-178 121-178
Plate : 121-100 FT 121-100 FT 121-100 FT
Gauge : 121-100 FT 121-100 FT 121-100 FT
Obl. : 121-100 FT 121-100 FT 121-100 FT
Req : 25 121-100 FT 121-100 FT 121-100 FT
LC : 121-100 FT 121-100 FT 121-100 FT
HI : 121-100 FT 121-100 FT 121-100 FT
Limit : 121-100 FT 121-100 FT 121-100 FT

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 15 MARCH 1953
Mfr : REMINGTON CORP CO.
Contr : EXP
Specs : EXP
Proj : EX-5 API
Group : FINE GRAIN S&S 7K
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	GRAINS	121-100 FT	375	2128	20°	-	RT	Not recovered
2	"	"	350	1998	20°	-	RT	Not recovered
3	"	"	400	2185	20°	-	RT	Not recovered
4	"	"	435	2338	20°	-	RT	Not recovered
5	"	"	440	2365	20°	-	RT	Not recovered
6	"	"	435	2347	20°	-	RT	Not recovered
7	"	"	435	2367	20°	-	RT	Not recovered
8	"	"	432	2327	20°	-	RT	Not recovered
9	"	"	430	2332	20°	-	RT	Not recovered
10	"	"	425	2296	20°	-	RT	Not recovered
11	"	"	430	2271	20°	-	RT	Not recovered
12	"	"	430	2349	20°	-	RT	Not recovered
13	"	"	428	MISS	20°	-	RT	Not recovered
14	"	"	428	2332	20°	-	RT	Not recovered
15	"	"	425	2272	20°	-	RT	Not recovered
16	"	"	428	2349	20°	-	RT	Not recovered
17	"	"	428	2349	20°	-	RT	Not recovered
18	"	"	428	2349	20°	-	RT	Not recovered
19	"	"	428	2349	20°	-	RT	Not recovered
20	"	"	428	2349	20°	-	RT	Not recovered
21	"	"	428	2349	20°	-	RT	Not recovered
22	"	"	428	2349	20°	-	RT	Not recovered
23	"	"	428	2349	20°	-	RT	Not recovered
24	"	"	428	2349	20°	-	RT	Not recovered
25	"	"	428	2349	20°	-	RT	Not recovered
26	"	"	428	2349	20°	-	RT	Not recovered
27	"	"	428	2349	20°	-	RT	Not recovered
28	"	"	428	2349	20°	-	RT	Not recovered
29	"	"	428	2349	20°	-	RT	Not recovered
30	"	"	428	2349	20°	-	RT	Not recovered
31	"	"	428	2349	20°	-	RT	Not recovered
32	"	"	428	2349	20°	-	RT	Not recovered
33	"	"	428	2349	20°	-	RT	Not recovered
34	"	"	428	2349	20°	-	RT	Not recovered
35	"	"	428	2349	20°	-	RT	Not recovered
36	"	"	428	2349	20°	-	RT	Not recovered
37	"	"	428	2349	20°	-	RT	Not recovered
38	"	"	428	2349	20°	-	RT	Not recovered
39	"	"	428	2349	20°	-	RT	Not recovered
40	"	"	428	2349	20°	-	RT	Not recovered
41	"	"	428	2349	20°	-	RT	Not recovered
42	"	"	428	2349	20°	-	RT	Not recovered
43	"	"	428	2349	20°	-	RT	Not recovered
44	"	"	428	2349	20°	-	RT	Not recovered
45	"	"	428	2349	20°	-	RT	Not recovered
46	"	"	428	2349	20°	-	RT	Not recovered
47	"	"	428	2349	20°	-	RT	Not recovered
48	"	"	428	2349	20°	-	RT	Not recovered
49	"	"	428	2349	20°	-	RT	Not recovered
50	"	"	428	2349	20°	-	RT	Not recovered
51	"	"	428	2349	20°	-	RT	Not recovered
52	"	"	428	2349	20°	-	RT	Not recovered
53	"	"	428	2349	20°	-	RT	Not recovered
54	"	"	428	2349	20°	-	RT	Not recovered
55	"	"	428	2349	20°	-	RT	Not recovered
56	"	"	428	2349	20°	-	RT	Not recovered
57	"	"	428	2349	20°	-	RT	Not recovered
58	"	"	428	2349	20°	-	RT	Not recovered
59	"	"	428	2349	20°	-	RT	Not recovered
60	"	"	428	2349	20°	-	RT	Not recovered
61	"	"	428	2349	20°	-	RT	Not recovered
62	"	"	428	2349	20°	-	RT	Not recovered
63	"	"	428	2349	20°	-	RT	Not recovered
64	"	"	428	2349	20°	-	RT	Not recovered
65	"	"	428	2349	20°	-	RT	Not recovered
66	"	"	428	2349	20°	-	RT	Not recovered
67	"	"	428	2349	20°	-	RT	Not recovered
68	"	"	428	2349	20°	-	RT	Not recovered
69	"	"	428	2349	20°	-	RT	Not recovered
70	"	"	428	2349	20°	-	RT	Not recovered
71	"	"	428	2349	20°	-	RT	Not recovered
72	"	"	428	2349	20°	-	RT	Not recovered
73	"	"	428	2349	20°	-	RT	Not recovered
74	"	"	428	2349	20°	-	RT	Not recovered
75	"	"	428	2349	20°	-	RT	Not recovered
76	"	"	428	2349	20°	-	RT	Not recovered
77	"	"	428	2349	20°	-	RT	Not recovered
78	"	"	428	2349	20°	-	RT	Not recovered
79	"	"	428	2349	20°	-	RT	Not recovered
80	"	"	428	2349	20°	-	RT	Not recovered
81	"	"	428	2349	20°	-	RT	Not recovered
82	"	"	428	2349	20°	-	RT	Not recovered
83	"	"	428	2349	20°	-	RT	Not recovered
84	"	"	428	2349	20°	-	RT	Not recovered
85	"	"	428	2349	20°	-	RT	Not recovered
86	"	"	428	2349	20°	-	RT	Not recovered
87	"	"	428	2349	20°	-	RT	Not recovered
88	"	"	428	2349	20°	-	RT	Not recovered
89	"	"	428	2349	20°	-	RT	Not recovered
90	"	"	428	2349	20°	-	RT	Not recovered
91	"	"	428	2349	20°	-	RT	Not recovered
92	"	"	428	2349	20°	-	RT	Not recovered
93	"	"	428	2349	20°	-	RT	Not recovered
94	"	"	428	2349	20°	-	RT	Not recovered
95	"	"	428	2349	20°	-	RT	Not recovered
96	"	"	428	2349	20°	-	RT	Not recovered
97	"	"	428	2349	20°	-	RT	Not recovered
98	"	"	428	2349	20°	-	RT	Not recovered
99	"	"	428	2349	20°	-	RT	Not recovered
100	"	"	428	2349	20°	-	RT	Not recovered

CONFIDENTIAL

SHEET NO. _____

Encl. ()

5E2BLT-F (CONT)

[illegible]

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

Temperature

Time
YF:
TS:
EL:
RA:

5E2BLT-C

Proj : EX-5
Gun : EX-178
Range : 1) 160FT
Plate : 673-11554
Gauge : 07789
Obl. : 30°
Req : 25
LC : 2701
HI : 2701
Limit : 2701

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 6 APRIL 1963
Mfr : ARASTING C.R.K. CO.
Contr : EXP.
Specs : EXP.
Proj : EX-5
Group : E2BLT-C (Common Ground)
Heat :
Steel :

Projectiles Fired at - 65° E. Powder Ambient

Rd.	Bullet	Proj. Wt. GRAMS	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	5E2BLT-C	1720	600	3018	30°	-	C	None off to armor
2	"	"	575	2957	30°	-	C	None off to armor
3	"	"	550	2953	30	-	I CIP	None off, 3/4" Hole
4	"	"	565	2912	30	-	I CIP	None off, 3/4" Hole
5	"	"	570	2918	30	-	C	None off, 3/4" Hole
6	"	"	565	2921	30	-	C	None off, 3/4" Hole
7	"	"	565	2927	30	-	C	None off, 3/4" Hole
8	"	"	560	2901	30	-	C	None off, 3/4" Hole
9	"	"	555	2886	30	-	I CIP	None off, 3/4" Hole
10	"	"	500	2650	30	-	I CIP	None off, 3/4" Hole
11	"	"	500	2643	30	-	I CIP	None off, 3/4" Hole
12	"	"	555	2876	30	-	I CIP	None off, 3/4" Hole
13	"	"	555	2886	30	-	I CIP	None off, 3/4" Hole
14	"	"	510	2658	30	-	I CIP	None off, 3/4" Hole
15	"	"	520	2701	30	-	I CIP	None off, 3/4" Hole
16	"	"	520	2752	30	-	C	None off, 3/4" Hole
17	"	"	520	2643	30	-	I CIP	None off, 3/4" Hole
18	"	"	520	2706	30	-	I CIP	None off, 3/4" Hole

CONFIDENTIAL

SECURITY INFORMATION

SHEET NO. _____

Encl. ()

[illegible]

~~CONFIDENTIAL~~

SECURITY INFORMATION

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NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
Time

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

582 BLT. M

Proj EX-5 :
Gun Mx-178 :
Range 1,160 FT :
Plate 675-A153 :
Gauge 5:739 :
Obl. 180 :
Req ± 25 :
LC 2681 :
HI 2645 V₉₀ :
Limit 2665 7153 :

C :
Mn:
S :
P :
Si:
Ni:
Cr:
Mo:

Date 6 APRIL 1953
Mfr ARMSTRONG CORP CO
Contr EXP
Specs EXP
Proj EX-5
Group 2 BLT-M (MEDIUM GRAIN)
Heat :
Steel:

Projectiles Fired AT-65°F: Powder Ambient

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	KNOWEN	GRAMS 1700 ± 20	600	3024	30°	—	2	Exit Hole Knocked Haze off to Band
2	"	"	575	2945	30	—	1	Missed - HIT old IMPACT
3	"	"	550	2856	30	—	2	Exit Hole Hole off to Band SENT
4	"	"	540	2800	30	—	2	Exit Hole Fractured Base, Upset
5	"	"	525	2727	30	—	2	CIP Exit Hole
6	"	"	535	2789	30	—	2	Exit Hole INTACT, SLIGHTLY upset
7	"	"	530	2762	30	—	2	Hole split off to ADAPT. KNOCKED EXIT HOLE
8	"	"	525	2752	30	—	2	CIP INTACT, Exit Hole
9	"	"	520	2727	30	—	2	CIP Exit Hole
10	"	"	500	2648	30	—	2	NO Hole off to BAND SENT
11	"	"	500	2643	30	—	2	RS " " " "
12	"	"	525	2757	30	—	2	RI " "
13	"	"	545	2740	30	—	2	CIP Hole off
14	"	"	520	2681	30	—	2	DISREGARD. HIT Previous impact
15	"	"	520	2681	30	—	2	Hole off to BAND SENT
16	"	"	530	2745	30	—	2	CIP Exit Hole Hole off
17	CONFIDENTIAL	"	545	2745	30	—	2	RS Hole off to Band SENT
18	SECURITY INFORMATION	"	525	2636	30	—	2	RS Hole off to Band SENT

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
C. ~~CONFIDENTIAL~~
Time

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Proj : 5 E2 34T- F
Gun : EX-5
Range : 81-78
Plate : 13 160 FT
Gauge : STS-81504
Obl. : 07759
Req : 25 : 30°
LC : 2600
HI : 2600
Limit : 2600 2700

C :
Mn :
S :
P :
Si :
Ni :
Cr :
Mo :

Date : 6 APRIL 1953
Mfr : ARMSTRONG CORK CO.
Contr : EXP
Specs : EXP
Proj : EX-5 ADP
Group : FINE GRAM 7 1/2 E291
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	GRAINS	1700	600	3037	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
2	"	"	575	2927	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
3	"	"	585	2960	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
4	"	"	580	2966	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
5	"	"	580	2969	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
6	"	"	575	2945	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
7	"	"	572	2939	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
8	"	"	570	2939	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
9	"	"	565	2932	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
10	"	"	500	2643	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
11	"	"	500	2648	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
12	"	"	500	2660	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
13	"	"	495	2742	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
14	"	"	520	2694	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
15	"	"	530	2740	30°	-	C	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
16	"	"	530	2748	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
17	"	"	570	2643	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE
18	"	"	500	2600	30°	-	I	NO ADAPTOR KNURL PENETRATED 1/2 IN. HOLE

CONFIDENTIAL

SECURITY INFORMATION

SHEET NO. _____

Encl. ()

(CONT)

[illegible]

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SHEET NO. 1
Encl. ()

YP:
TS:
EL:
RA:

Proj	20mm FX-57	20mm FX-57	20mm FX-57
Gun	34482	34472	34492
Range	160FT	160FT	160FT
Plate	2 - 253048	2 - 254048	23 - 253841
Gauge	0.301	0.499	0.498
Obl.	30°	30°	30°
Req ± 25			
LC	1958	2017	1978
HI	1919	2018	1978
Limit	1939	2013	1978

C :
Mn:
S :
P :
Si:
Ni:
Cr:
Mo:

Date : 21 MAY 1953
Mfr :
Contr: 22055TING CORK LAMBER 17
Specs: EXP NATIONAL C.A.
Proj: EXP
Group: EX-5
Heat: A-8
Steel:

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX5	GRAINS 1700T30	290	1836	30°	—	—	BASE IN PLATE
2	"	"	260	1666	30°	—	I RT	BASE IN PLATE
3	"	"	275	1731	30°	—	I RT	BASE IN PLATE
4	"	"	285	1798	30°	—	I RT	BASE IN PLATE
5	"	"	295	1876	30°	—	I RT	BASE IN PLATE
6	"	"	305	1919	30°	—	I RT	BASE IN PLATE
7	"	"	315	2006	30°	—	C FCIP	BASE IN PLATE
8	"	"	320	2022	30°	—	C FCIP	BASE IN PLATE
9	"	"	325	2088	30°	—	C FCIP	BASE IN PLATE
10	"	"	310	1958	30°	—	C FCIP	BASE IN PLATE
11	"	"	322	2042	30°	—	C FCIP	BASE IN PLATE
12	"	"	322	2052	30°	—	C FCIP	BASE IN PLATE
13	"	"	322	2051	30°	—	C FCIP	BASE IN PLATE
14	"	"	322	2033	30°	—	C FCIP	BASE IN PLATE
15	"	"	322	2056	30°	—	C FCIP	BASE IN PLATE
16	"	"	322	2035	30°	—	C FCIP	BASE IN PLATE
17	CONFIDENTIAL	CONFIDENTIAL	322	2051	30°	—	C FCIP	BASE IN PLATE
18	SECURITY INFORMATION	CONFIDENTIAL	322	2026	30°	—	C FCIP	BASE IN PLATE

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NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

S78-1(54-20mm)

Encl. ()

PLATE 1 (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
19	EX-5	GRAMS 1700 EXO	322	2051	30°	—	C FAIR	BASE IN PLATE Hole in Box
20	"	"	322	2060	30°	—	C FAIR	same as Rd 19
PLATE 2								
1	EX-5	1700 EXO	310	1921	30°	—	T	Base in Box Hole in Box
2			315	1987		—	T	Base in Box
3			320	2030		—	C FAIR	BASE IN PLATE
4			318	2025		—	C FAIR	same as Rd 3
5			316	2008		—	T	BASE REJECTED Hole in Box
6			317	2017		—	C FAIR	BASE IN PLATE Hole in Box
7			330	2106		—	C	3/4" Hole BASE IN BOX
8			330	2102		—	C	3/4" Hole - Box PROJ BRKLY
9			330	2085		—	C	3/4" Hole - Box PROJ BRKLY
10			330	2108		—	C	3/4" Hole INTACT Hole in Box
11			330	2094		—	C	BASE IN BOX Hole in Box
12			330	2097		—	T	BASE IN BOX Hole in Box
13			330	2105		—	C	BASE IN BOX Hole in Box
14			330	2087		—	DISREGARD	Hole in Box
15			330	2096		—	C	BASE LOST Hole in Box
16			330	2194		—	C FAIR	BASE IN BOX Hole in Box
17	CONFIDENTIAL		Y103			—	C FAIR	BASE IN BOX Hole in Box

SECURITY INFORMATION

PROJECTILE

PROJECTILE FIRING RECORD

878.1(54.20mm)

SHEET NO. _____

Encl. ()

PLATE 3

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
1	EX-5	GRAINS 1700570	310	1970	30°	—	T. F.P.	Nose between box and plate
2			310	1934		—	T. F.P.	Nose between plate and box
3			315	2022		—	C. F.P.	Nose in box
4			312	1987		—	T. F.P.	Nose between plate and box
5			314	2001		—	C. F.P.	Nose in box
6			313	1978		—	C. F.P.	Nose in box
7			311	1978		—	T. F.P.	Nose between plate and box
8			328	2079		—	C.	Nose between plate and box
9			328	2080		—	C. F.P.	Nose in box
10			328	2102		—	C.	Nose in box
11			328	2079		—	C. F.P.	Nose in box
12			328	2085		—	C. F.P.	Nose in box
13			328	2082		—	C.	INTACT
14			328	2088		—	C. F.P.	Nose in box
15			328	2121		—	C.	BROKEN - IN
16			328	2089		—	C. F.P.	Nose in box
17			328	2106		—	C. F.P.	Nose in box

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

30" Ammo

YP:
TS:
EL:
RA:

Proj : EX-5
Gun : 6mm EX-171
Range : 1160 FT
Plate : 4" 265MM
Gauge : 101 717
Obl. : 30°
Req ± 25 :
LC : 1272
HI : 1274
Limit : 1272

C :
Mn :
B :
P :
Si :
Ni :
Cr :
Mo :

Date : 101 MAY 1953
Mfr : ARNSTEIN CO. NATIONAL BATTERY
Contr : EXP
Specs : EXP
Proj : EX-5
Group : A-8
Heat :
Steel :

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-5	GRAINS 1700 ± 20	550	2867	30°	—		DISCARDED
2			570	2854		—	C	4" Hole
3			550	2867		—	C	4" Hole, 20mm
4			530	2789		—	C	Base in plate
5			520	2742		—	C	Base in plate, data torn off
6			500	2633		—	T	RT 4" Hole, data off
7			510	2662		—	T	RT 4" Hole, data off to back
8			510	2665		—	T	RT 4" Hole, data off
9			515	2704		—	T	RT 4" Hole, data off
10			548	2842		—	C	Base in plate
11			550	2854		—	C	Base in plate, data torn off
12			548	2842		—	C	Base in plate, data torn off
13			550	2881		—	C	Base in plate, data off to back
14			549	2856		—	C	4" Hole, " " " "
15			549	2873		—	C	4" Hole, " " " "
16			549	2870		—	C	Base in plate
17			549	2864		—	C	Base in plate, data torn off
18			549	2861		—	C	4" Hole, data off to back

CONFIDENTIAL

SECURITY INFORMATION

NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

878-1(54-20mm)

Encl. ()

PLATE 4 (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
19	AX-5	GRAINS 1700 I 20	549	2867	30	- C		Base in Plate Hole 1/2" dia.
PLATE 5								
1	AX-5	1700 I 20	430	2624	30	- C		Base in Box Hole 1/2" dia. - Base in Plate
2			400	2475		- I		Hole in Plate Hole 1/2" dia. - Base Rejected
3			415	2551		- I		Hole off - 1/2" dia. H. Hole 1/2" dia. - Base
4			440	2580		- I		Hole off - 1/2" dia. H. Hole 1/2" dia. - Base in Plate
5			445	2592		- I		CIP 1/2"
6			428	2607		- I		RT 1/2" Pen ST. Base Rejected
7			430	2605		- C		Hole 1/2" dia. Broken
8			427	2590		- I		RT 1/2" Pen ST. (and Seal) Broken - in Box
9			455	2706		- C		Hole 1/2" dia.
10			457	2719		- C		Broken - in Box Hole 1/2" dia.
11			457	2714		- I		CIP 1/2" Pen ST.
12			457	2717		- C		Hole 1/2" dia. Broken. Hole 1/2" dia. - in Box
13			457	2699		- I		Hole 1/2" dia. - in Box Base Rejected
14			457	2711		- I		Hole 1/2" dia. - in Box Hole 1/2" dia. - Base Rejected
15			457	2717		- C		Hole 1/2" dia. - in Box Hole 1/2" dia. - Base in Plate
16			457	2699		- C		Hole 1/2" dia. - in Box Hole 1/2" dia. - Base in Plate
17			457	2714		- C		Hole 1/2" dia. - in Box Hole 1/2" dia. - Base in Plate
18			457	2706		- C		Hole 1/2" dia. - in Box Hole 1/2" dia. - Base in Plate
19			457	2719		- I		CIP 1/2" Pen ST.

CONFIDENTIAL

SECURITY INFORMATION

PROJECTILE

S78-1(54-20)

Encl. ()

PLATE 5 (CONT)

[illegible]

NAVAL PROVING GROUND
LIGHT ARMOR BATTERY
Temperature

PROJECTILE FIRING RECORD
Time

SHEET NO. 1
Encl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YP:
TS:
EL:
RA:

Proj 20MM EX-5 181-5 121-5 C :
Gun 54442 134492 84492 Mn:
Range 11,160 11,160 11,160 E :
Plate 26 (650) 27 (650) 27 (650) P :
Gauge 10.496 10.505 10.506 S1:
Obl. 130° 130° 130° N1:
Req : 25 1 1 1 Cr:
LC 1026 12207 1087 Mo:
NI 1026 12199 12199 12199
Limit 1026 12199 12199 12199

Date : 4 JUNE 1953

Mfr Armstrong Cork Co. - National

Contr: EXP

Specs: EXP

Proj: EX-5

Group: A-B

Heat :

Steel:

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet	Condition of Bullet
1	EX-5	Grains 1200 1200	280	Miss	30°	—	I RJ	Nose off To Band S.
2			280	1767		—	I RJ	" " "
3			300	1881		—	I RJ	5/8" Pun.
4			310	1865		—	C	5/8" Pun in Box, No. 1
5			305	1824		—	I RJ	1/2" Pun st.
6			308	1969		—	C (RJ)	1/2" Pun in Box
7			307	1940		—	C (RJ)	1/2" Pun in Box
8			306	1924		—	I RJ	Nose off To Band S.
9			306	1936		—	C RJ	3/4 x 3/4" Pun Th - open
10			308	1932		—	I RJ	Nose off To Band S.
11			320	2022		—	C (RJ)	5/8 x 3/4" Pun In Box
12			322	2060		—	C (RJ)	Nose off To Band S.
13			321	2044		—	C (RJ)	5/16 x 1/2 Pun In Box
14			320	2036		—	C (RJ)	Nose off To Band S.
15			320	2027		—	C (RJ)	1/2 x 1/2 Pun In Box
16			320	2033		—	I RJ	Nose off To Band S.
17	CONFIDENTIAL		2051			—	C (RJ)	Nose off To Band S.
18	SECURITY INFORMATION		2030			—	I RJ	3/4 Pun Th - Not in

NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

S78-1(54-20mm)

Encl. ()

PLATE # 6 (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
19	EX-5	1700 EXO GRAINS	370	2015	30°	—	C (PT)	9" X 11" 7 in in Box
20	"	"	370	2015	"	—	C (PT)	" " " " " "
21	EX-5	1700 EXO	355	2258	30°	—	C (PT)	7 in in Box. Nose off
22	"	"	370	2388	"	—	C (PT)	7 in in Box. Nose off
23	"	"	380	2398	"	—	C (PT)	7 in in Box. Nose off
24	"	"	380	2372	"	—	C (PT)	7 in in Box. Nose off
25	"	"	360	2316	"	—	C (PT)	7 in in Box. Nose off
26	"	"	380	2427	"	—	C (PT)	7 in in Box. Nose off
27	"	"	380	2475	"	—	C (PT)	7 in in Box. Nose off
28	"	"	390	2475	"	—	C (PT)	7 in in Box. Nose off
29	"	"	390	2482	"	—	C (PT)	7 in in Box. Nose off
30	"	"	400	2530	"	—	C (PT)	7 in in Box. Nose off
31	"	"	375	2396	"	—	C (PT)	7 in in Box. Nose off
32	"	"	475	2633	"	—	C (PT)	7 in in Box. Nose off
33	"	"	410	2548	"	—	C (PT)	7 in in Box. Nose off
34	"	"	375	2409	"	—	C (PT)	7 in in Box. Nose off
35	"	"	372	2396	"	—	C (PT)	7 in in Box. Nose off
36	"	"	400	2522	"	—	C (PT)	7 in in Box. Nose off
37	"	"	405	2535	"	—	C (PT)	7 in in Box. Nose off

PROJECTILE

878-1(54-20)

Encl. ()

[illegible]

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NAVAL PROVING GROUND

PROJECTILE FIRING RECORD

SHEET NO. _____

PROJECTILE

S78-1(54-20mm)

Encl. ()

PLATE # 7 (CONT)

Rd.	Bullet	Proj. Wt.	Charge	Str. Vel.	Obl.	Yaw	Penet.	Condition of Bullet
1	EX-5	1700±20	360	2316	30°	—	C (PT)	7/8 x 1/4 Ann. Upd in
2				2298		—	C (PT)	Nose off to base
3				2280		—	T PT	7/8" D.H. 37
4				2312		—	C (PT)	7/8" D.H. 37
5				2340		—	C (PT)	7/8" D.H. 37
6				2316		—	C (PT)	Nose off to base 3/4
7	✓	✓	✓	2320	✓	—	C (PT)	7/8" D.H. 37
8			390	2421		—	C. SAID	Nose off to base 3/4
9			410	2537		—	C	Nose off to base 3/4
10			400	2484		—	C	Nose off to base 3/4
11			395	MISS		—	DISCARDED	
12			395	2480		—	C	DISCARDED
13			393	2355		—	DISCARDED	DISCARDED
14			393	2460		—	C (PT)	Nose off to base 3/4
15			400	2530		—	C (PT)	Nose off to base 3/4
16			420	2600		—	C	Nose off to base 3/4
17			440	2662		—	C	Nose off to base 3/4
18			430	2645		—	C	Nose off to base 3/4
19			11A	2553	✓	—	C	Nose off to base 3/4

CONFIDENTIAL

SECURITY INFORMATION

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PROJECTILE

878-1(54-20mm)

Encl. ()

PLATE 9

[illegible]

NAVAL PROVING GROUND
LIGHT ARTILLERY BATTERY
Temperature

PROJECTILE FIRING RECORD
FIRE

SHEET NO. 1
Ensl. ()

Anneal :
Norm :
Harden :
Quench :
Draw :

YF:
TF:
EL:
RA:

Proj : 100-5
Gun : 100-5
Range : 100-5
Plate : 100-5
Gauge : 100-5
Obl. : 100-5
Req : 25
V : 100-5
HI : 100-5
Limit : 100-5

C :
M :
A :
P :
B :
N :
O :
M :

Date : 15 June 1953
M :
C :
S :
P :
H :
S :

Ed.	Bullet	Proj. Wt.	Charge	Str. Vol.	Obl.	Yaw	Penetration	Condition of Bullet
1	100-5	6000	425	2552	0	-	100	100% Intact, G.
2			440	2658		-	100	100% Intact, G.
3			450	2676		-	100	100% Intact, G.P.
4			465	2760		-	100	100% Intact, G.
5			460	2722		-	100	100% Intact, G.
6			455	2727		-	100	100% Intact, G.
7			455	2711		-	100	100% Intact, G.
8			452	2714		-	100	100% Intact, G.
9			490	2831		-	100	100% Intact, G.
10			488	2804		-	100	100% Intact, G.
11			488	2828		-	100	100% Intact, G.P., Intact
12			488	2804		-	100	100% Intact, G.P.
13			488	2825		-	100	100% Intact, G.P.
14			488	2856		-	100	100% Intact, G.P., Intact
15			488	2836		-	100	100% Intact, G.P.
16			488	2853		-	100	100% Intact, G.P., Intact
17			488	2853		-	100	100% Intact, G.P.
18			488	2842		-	100	100% Intact, G.P.

CONFIDENTIAL

SECURITY INFORMATION